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ST-84

25 YEAR RE-REVIEW



## CROSS SECTION EVALUATION

For ST-84

Date of Test:	29 November 1966
Data Run:	29 November 1966
Report Issued:	2 December 1966
Aircraft No.:	132
Flight No.:	126

## ABSTRACT

This report provides test data on aircraft No. 132 from Flight No. 126, conducted on 29 November 1966. The data and results are accompanied by explanatory notes and qualifying statements. Information is contained in data recorded during the inbound and outbound runs. AR data was obtained with the Bendix, Navy and MOD III Systems. The following reduced data, in computer printout form suitable for analysis, is provided in this report:

- 1) One flight plan (elevation angle versus slant range)
- 2) One flight plan (azimuth angle versus ground range)
- 3) One azimuth and elevation angle versus time plot
- 4) One PHD and range versus time plot for each of the following systems: Bendix, Navy and MOD III
- 5) One PHD clutter and range versus time plot for the Navy System
- 6) One cross section and range versus time plot for each of the following systems: Bendix, Navy and MOD III
- 7) Internal r-f calibration plots (PHD versus attenuation) for the Bendix, Navy and MOD III Systems with the range gate set at 13.53, 29.73 and 49.84 nautical miles.

FLIGHT PLANS

AZIMUTH AND  
ELEVATION ANGLES

PHD

CLUTTER

SIGMA

INTERNAL  
R-F CALIBRATIONS

## RADAR CROSS SECTION EVALUATION

### FOR ST-84

#### 1.0 INTRODUCTION

##### 1.1 Scope

This report contains information obtained during Flight No. 126 conducted on 29 November 1966 to measure radar skin return from aircraft No. 132.

Information provided in the report includes a chronological record of comments from the flight test operations log book, reduced data plotted in graphic form suitable for analysis, and a theoretical interpretation of the reduced data with regard to its validity or qualifications.

##### 1.2 Purpose

This flight test was conducted under operational conditions to obtain basic radar cross section data on aircraft No. 132. No electronic countermeasure (ECM) or electronic warfare systems (EWS) equipment was tested. This aircraft has a special paint treatment.

#### 2.0 TEST RESULTS

Table 1 lists the significant events noted at the radar control center during Flight Test No. 126.

##### 2.1 Flight Plans

The radar slant range versus elevation angle for the approach portion of the flight is shown in Flight Plan 1. For the refractive index model selected, the altitude of the aircraft appeared to be between 72,000 and 75,000 feet, relative to the radar test site, for the inbound run.

Table 1: Flight Test Operations Log--ST-84

TIME	OPERATION	RANGE (Naut. Mi.)	REMARKS
1400:00	Red check OK		
1412:59	Vehicle airborne		
1414:10	Nike in auto track	9	Vehicle outbound
1414:15	DSK slaved		
1416:03	Range check	20	
1418:32	Range check	40	
1418:55	Nike broke track		
1421:40	Started internal calibrations		
1434:25	Completed internal calibrations		
1450:00	Nike in auto track	255	Vehicle inbound
1450:05	DSK slaved		
1450:55	Data tapes ON	226.7	
1451:49	Bendix video threshold	199.8	
1453:28	Range check	149.5	
1455:07	Range check	99.5	
1456:25	Range check	59.8	
1457:53	Range check	19.6	
1458:26	CPA	11.7	
1459:30	Nike discontinued track	29.4	Vehicle outbound
1459:40	Data tapes OFF		Test completed

The F Plan plot is a computer printout of Flight No. 126 showing computed ground range versus the azimuth angle. The first data point on the inbound run at 1451:50 is marked with an asterisk. Time intervals of one minute are indicated by solid squares, and the final data point is identified by an open square. As the plot shows, the aircraft approached the radar station from 340 degrees. The data point nearest the radar station occurred at 1458:26 at an elevation angle of 85.3 degrees and a slant range of 11.7 nautical miles. This corresponds to a ground range minimum of 0.96 nautical miles at this point.

## 2.2 Azimuth and Elevation Plots

The azimuth and elevation plot is a computer printout of data from the Central Reference Servo System (CRS). The CRS was previously described in EG&G Flight Test report BD-48. The rapid increase in elevation angle, peaking at 1458:26, is indicative of the close approach of the aircraft.

At 1459:25 the test data was terminated with the final azimuth and elevation angles of 151.9 degrees and 22.5 degrees, respectively.

## 2.3 AR Data/Bendix System

The Bendix System was operated in the monostatic configuration to obtain cross section data for horizontal polarization in S-band (2.73-2.98 GHz). The PHD record indicates the threshold occurred near initial lock-on at 1250:56. The PHD count increases as the range decreases until a maximum PHD is reached at minimum range. There is no clutter gate provision for the Bendix System. Values ranging from -1 to +7 dB above 1 square meter were computed for the cross section of aircraft No. 132 at S-band, with an average of approximately 2.5 dBsm. Cross section data obtained after 1457:06 may be invalid because the maximum slew rate of the DSK is insufficient to provide antenna tracking as the vehicle passes nearly overhead.

#### 2.4 AR Data/Navy System

The Navy System was operated in the monostatic configuration to obtain cross section data for horizontal polarization at 173 MHz. The PHD record indicates that threshold occurred at a range of about 140 nautical miles at 1453:45.

A clutter plot is also provided which defines a range gate response approximately 2 nautical miles farther than the target return. Signals noted simultaneously in both gates indicate an external signal source; the data should be smoothed over such intervals.

If the PHD reading for the clutter gate is 70 counts or more below the range gate, an error of one decibel or less is incurred for normal clutter returns. On this basis, the PHD plot for the Navy System is considered valid beginning at time 1454:21. The PHD plots are converted to Navy System sigma plots to permit a printout of cross section in decibels referenced to one square meter.

The plot of cross section data versus time for the Navy System indicates that the cross section varied widely, with a maximum of approximately 14 dBsm. Cross section data obtained between 1457:51 and 1459:01 is considered invalid because the maximum slew rate of the DSK is insufficient to permit antenna tracking as the vehicle passes nearly overhead.

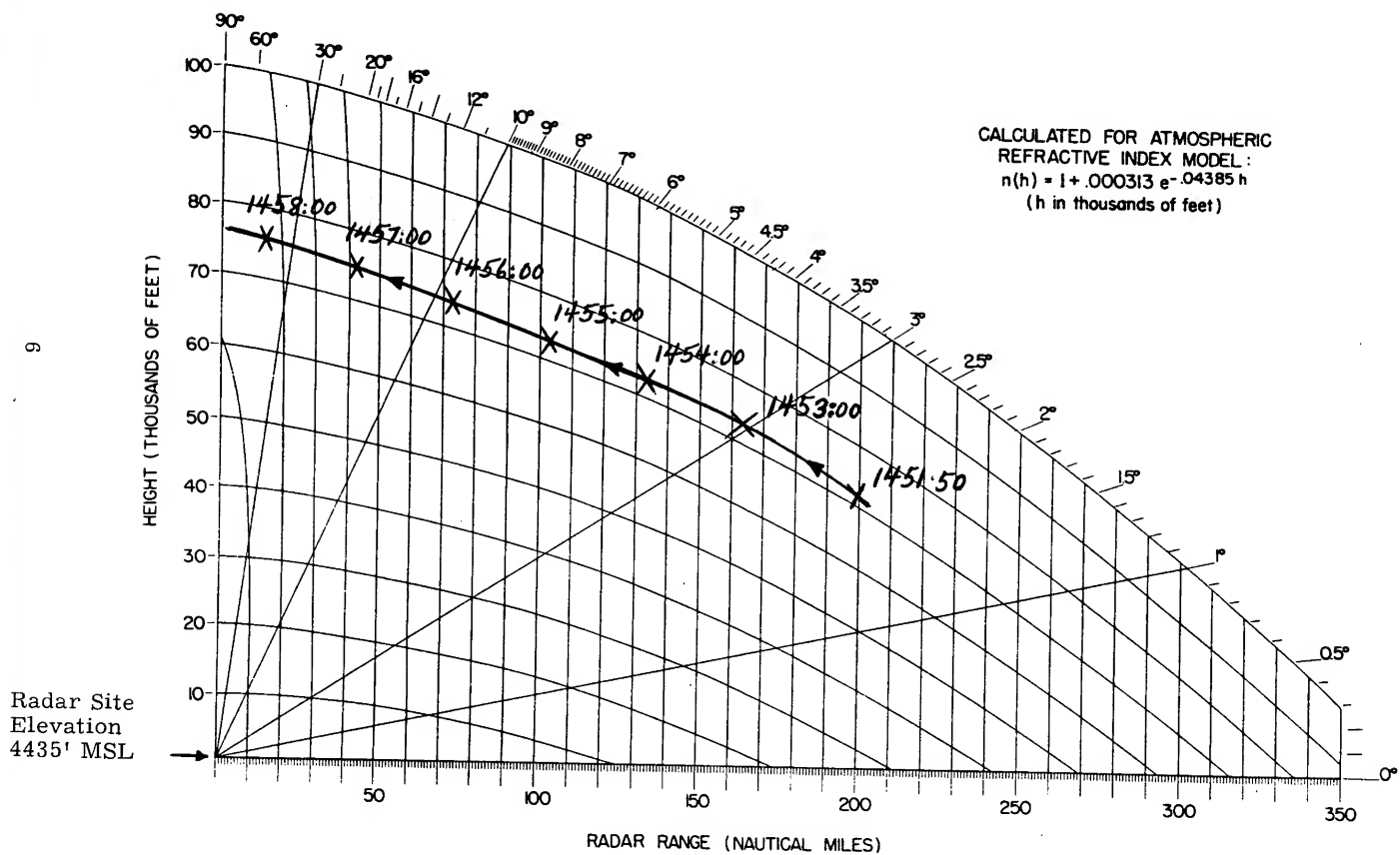
#### 2.5 AR Data/MOD III System

The MOD III System was operated in the monostatic configuration to obtain cross section data for vertical polarization in the C-band (5.47 GHz). The MOD III has no provision for a clutter gate. The PHD record indicates the initial threshold occurred at a range of about 64 nautical miles at 1456:16. The PHD count increases as the range decreases until a maximum PHD is reached at minimum range. Radar cross section data from approximately 1456:16 to 1458:15 is considered valid. Data dropout from about 1458:15 to 1458:45 is probably due to insufficient antenna slew rate to permit tracking as the vehicle passed nearly overhead. Values as high as 18 dB above 1 square meter were computed for the cross section of aircraft No. 132 at C-band.



3.0 SPECIAL DATA NOTES

Aircraft No. 132 does not have the modification which would permit installation of the telemetry package. For this reason, roll, pitch, and heading data are not included in this report. Calculation of look and depression angles has therefore been omitted. It should be noted that the Bendix System was receiving in the horizontal polarization mode; the Bendix normally receives in the vertical mode.

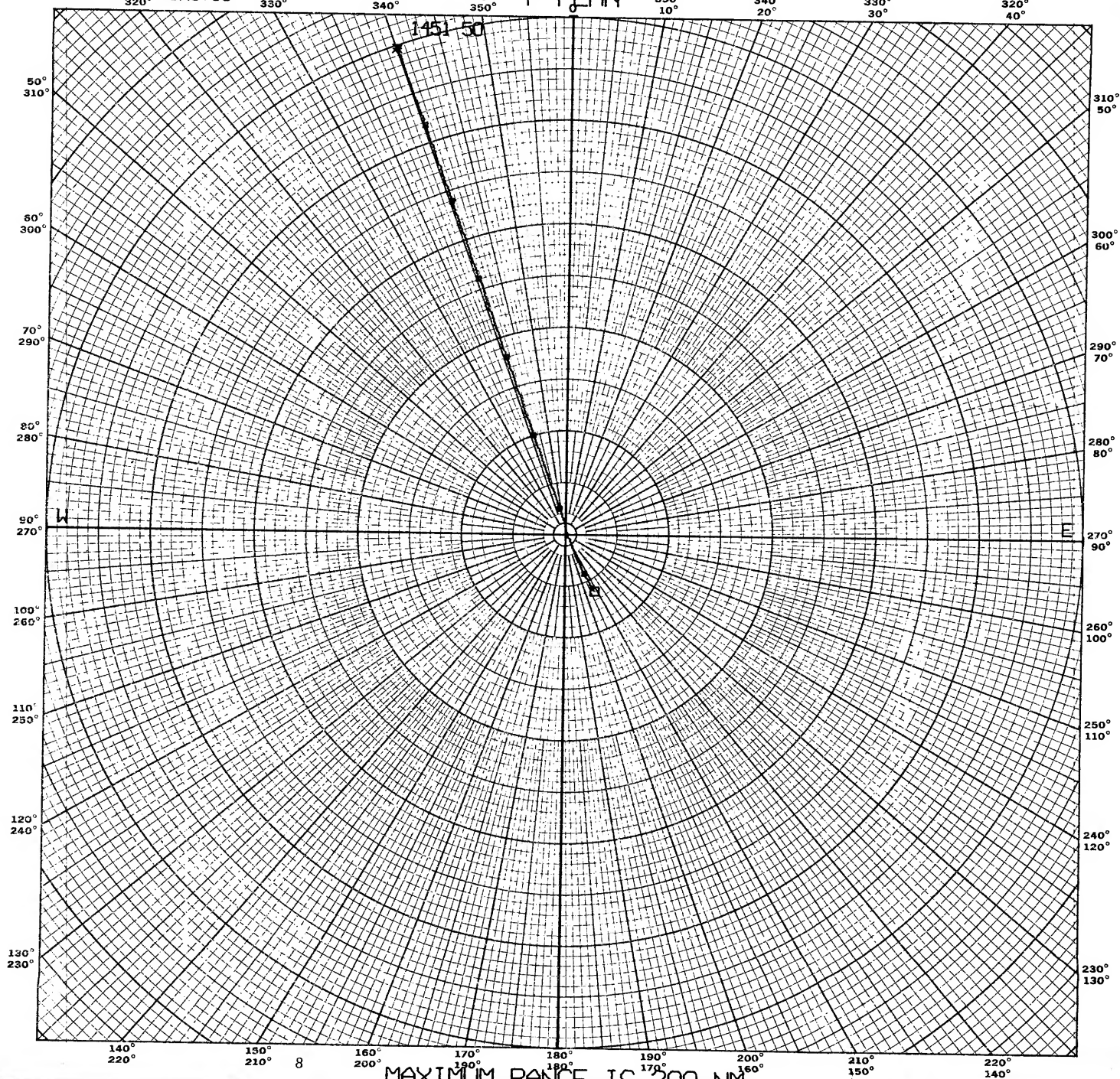


Flight Plan 1

FLIGHT PLANS

ST-84 40° 29NOV66  
320°

F PLAN



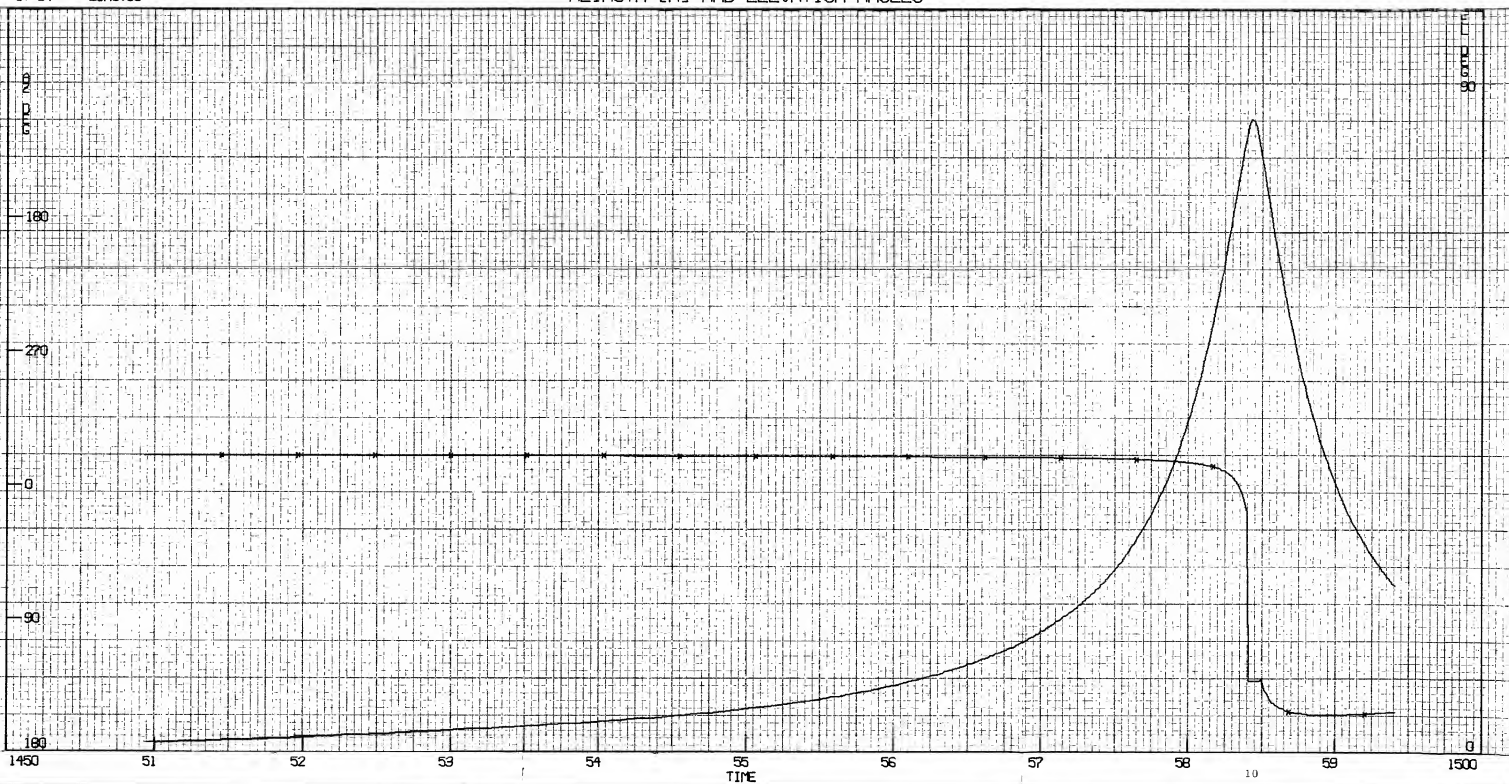
MAXIMUM RANGE IS 200 NM

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AZIMUTH AND  
ELEVATION ANGLES

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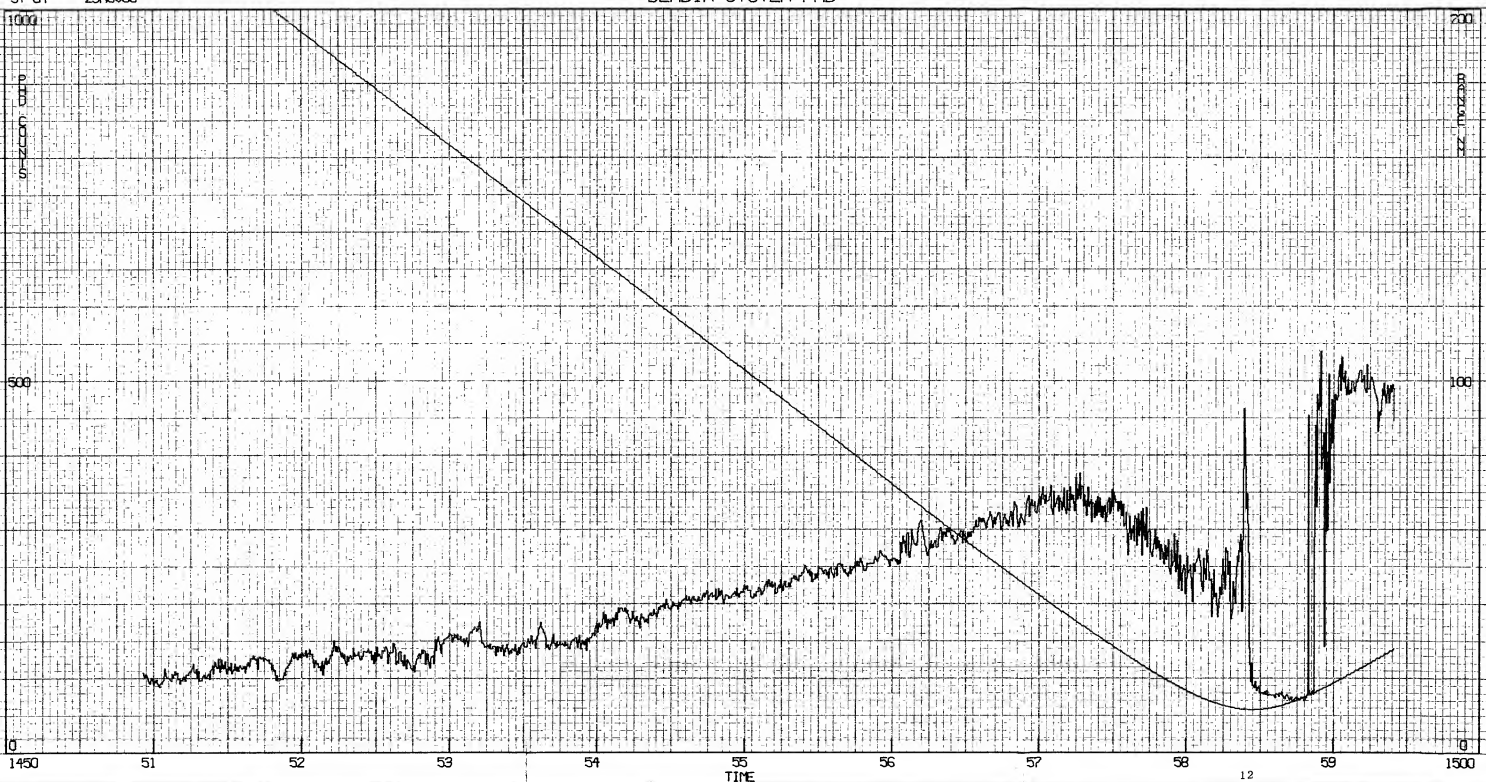
AZIMUTH [X] AND ELEVATION ANGLES



PHD

ST-84 29NOV66

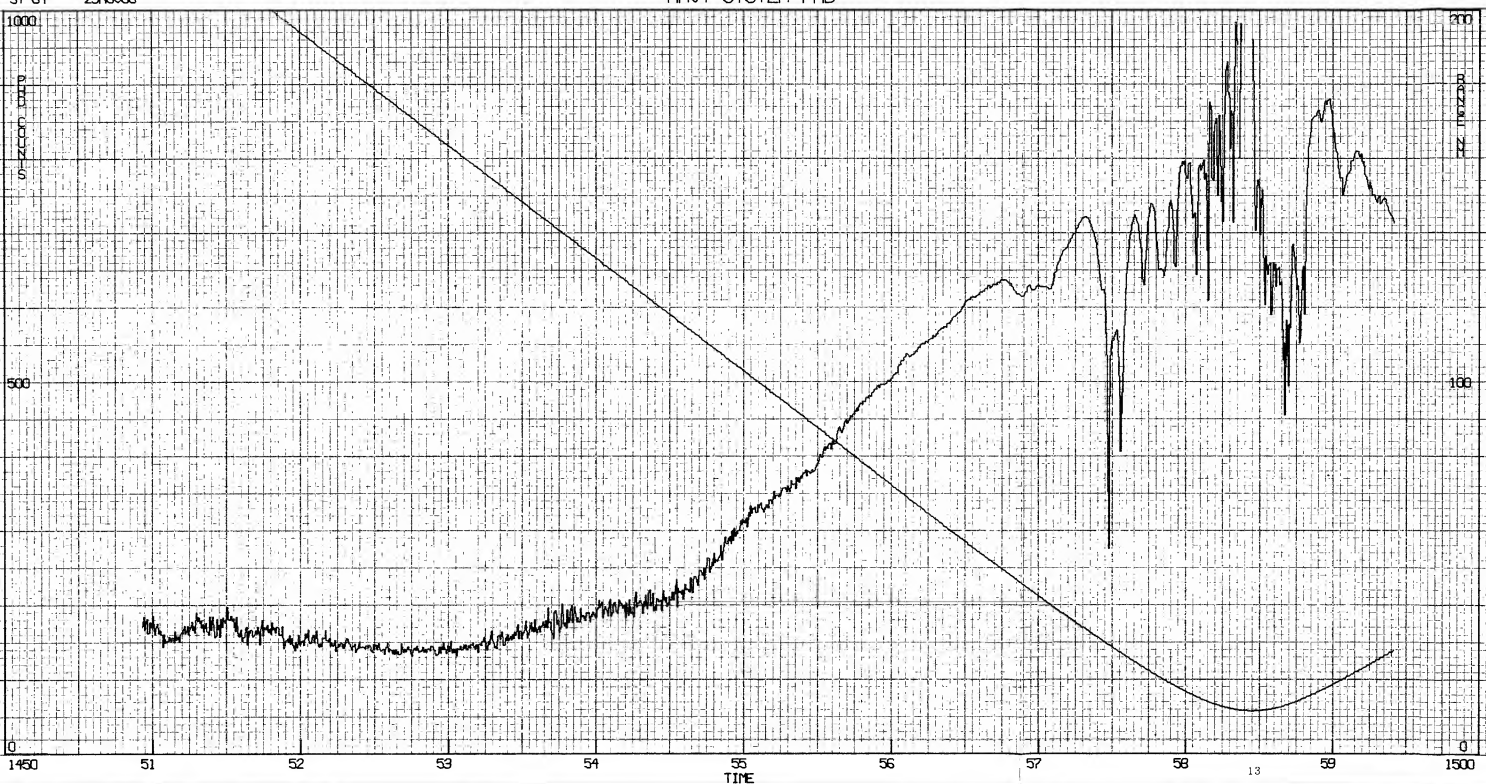
BENDIX SYSTEM PHD





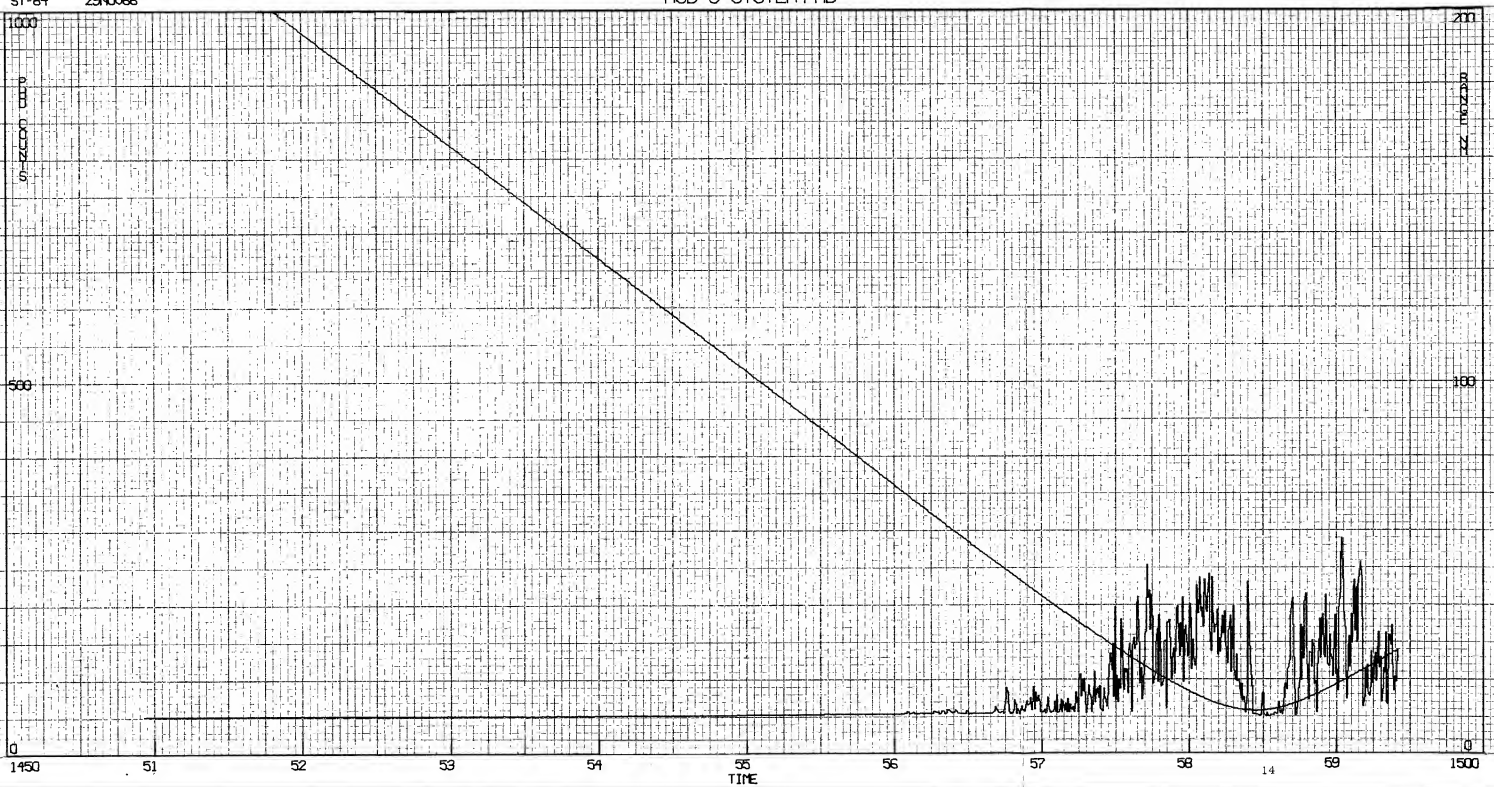
ST-84 29NOV65

NAVY SYSTEM PHD

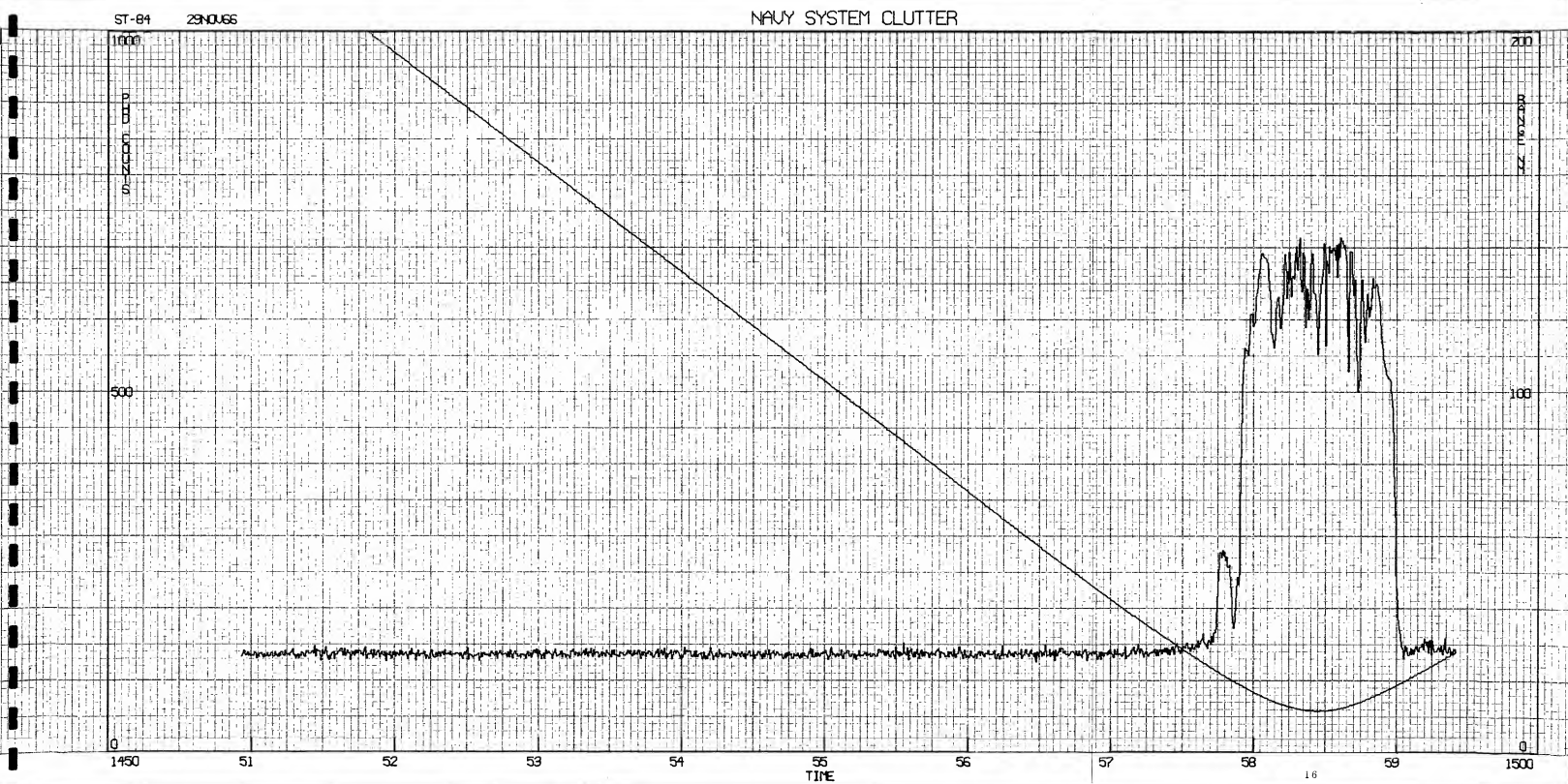


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MOD 3 SYSTEM PHD



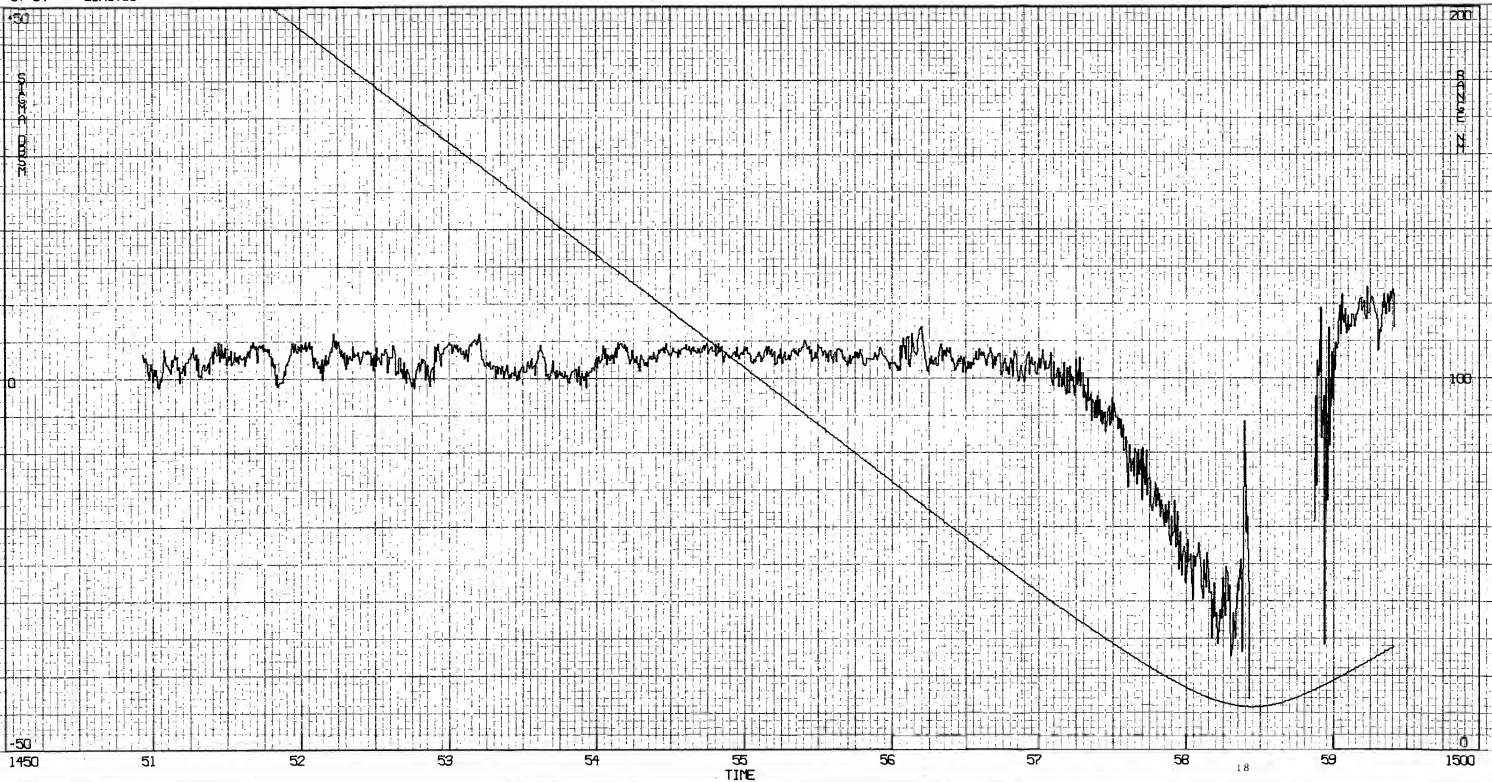
CLUTTER



SIGMA

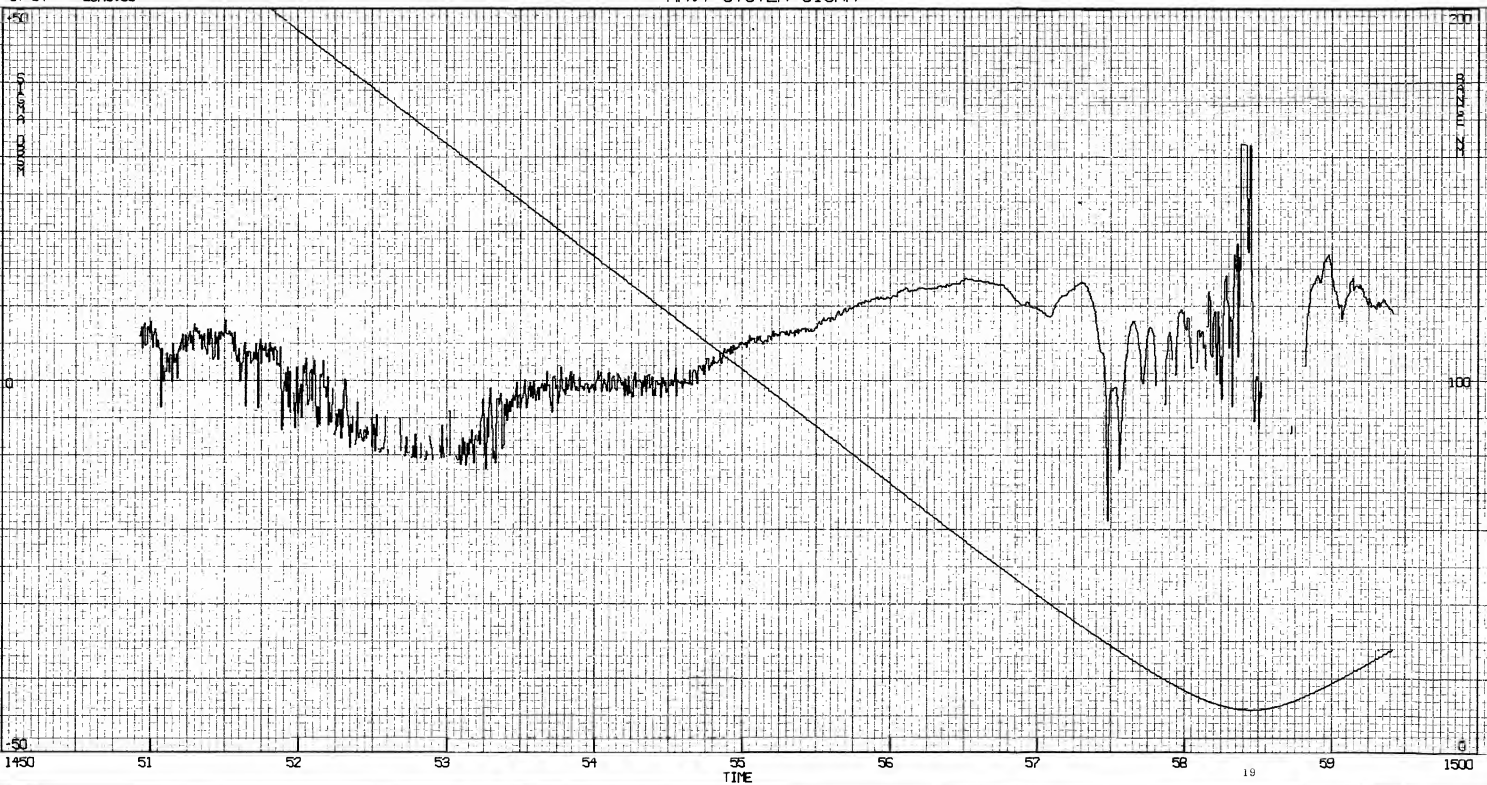
ST-84 29NOV65

BENDIX SYSTEM SIGMA



ST-64 29NOV66

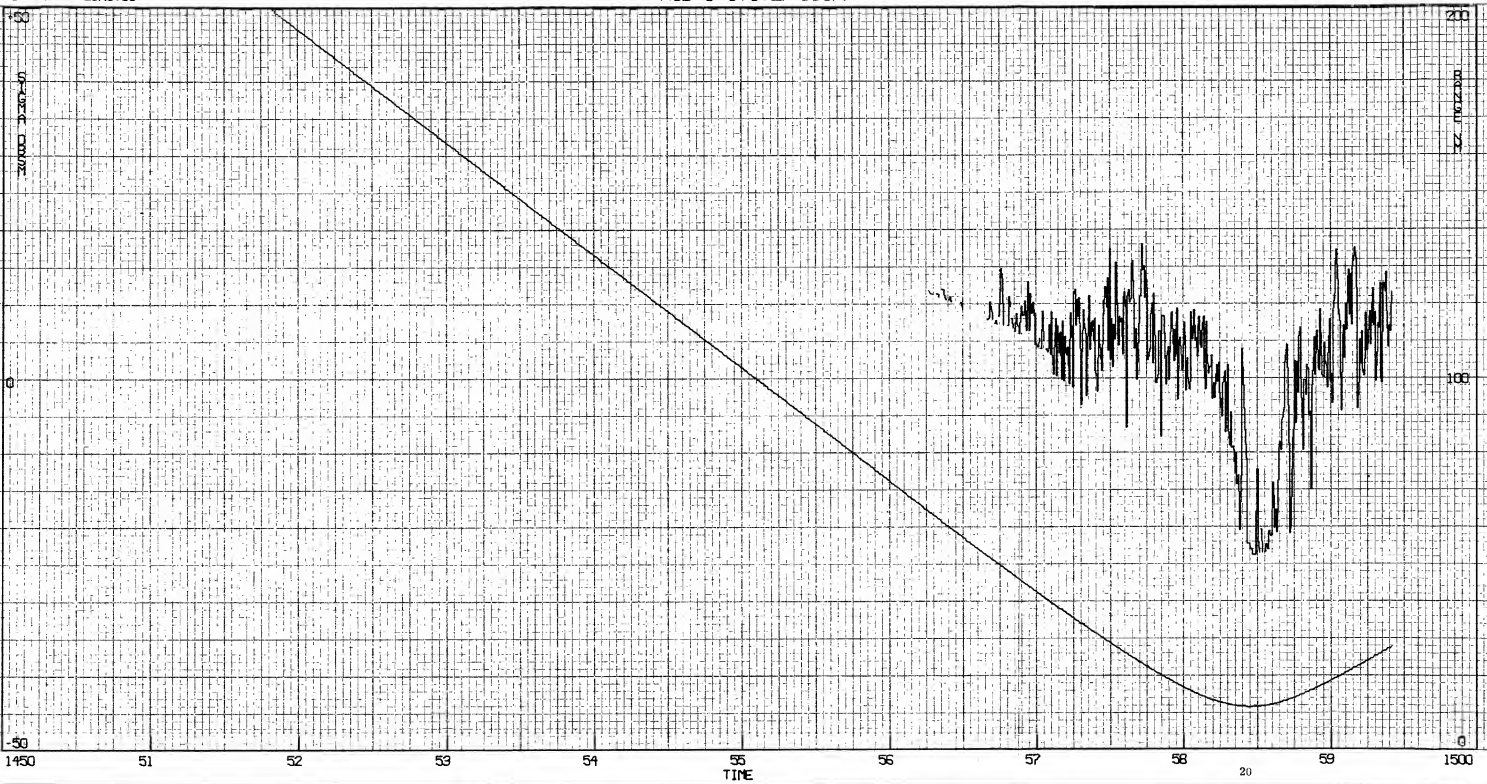
NAVY SYSTEM SIGMA





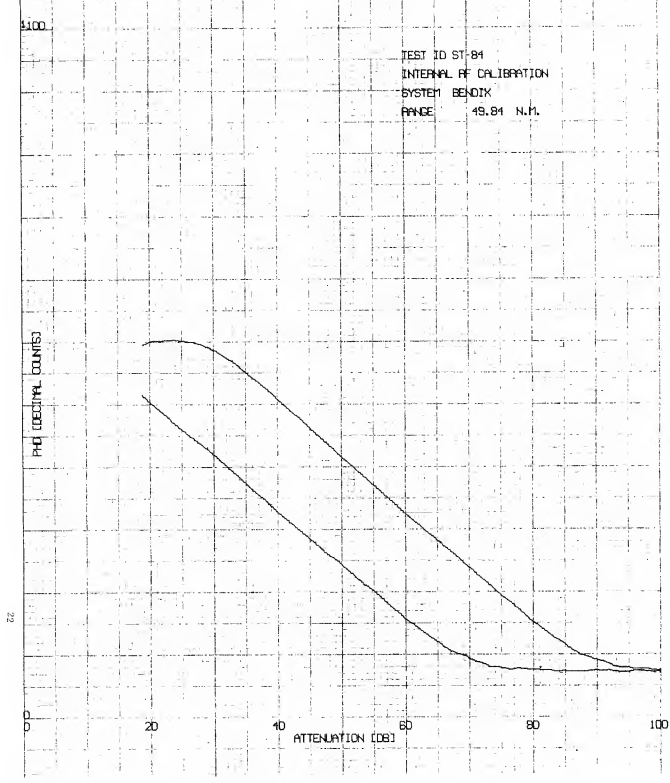
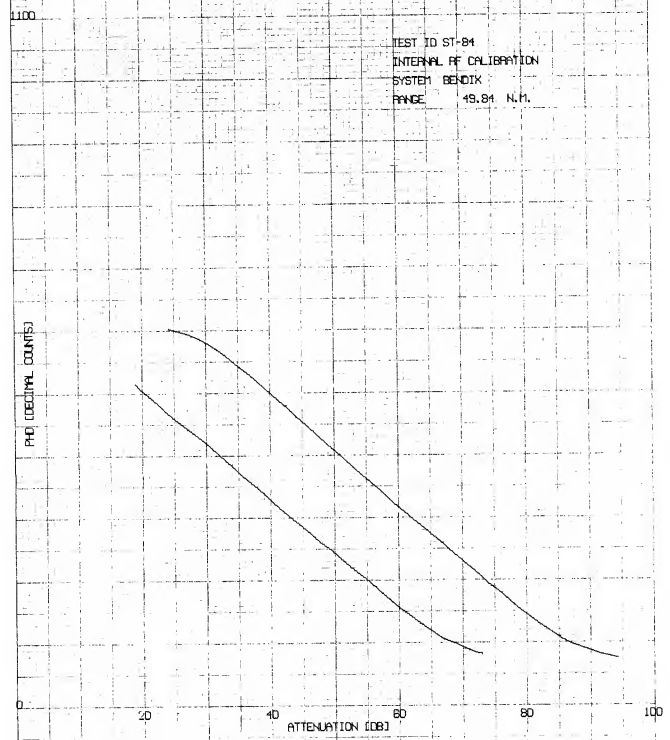
ST-84 23NO66

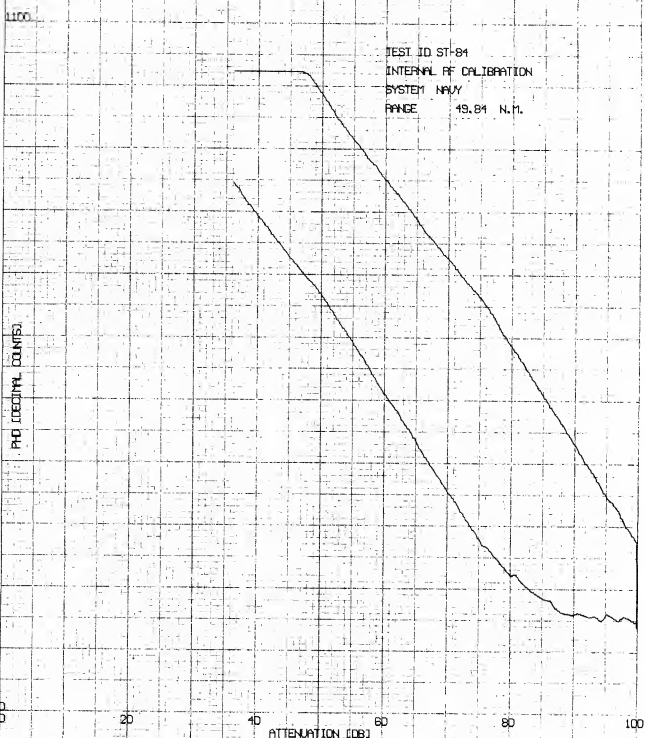
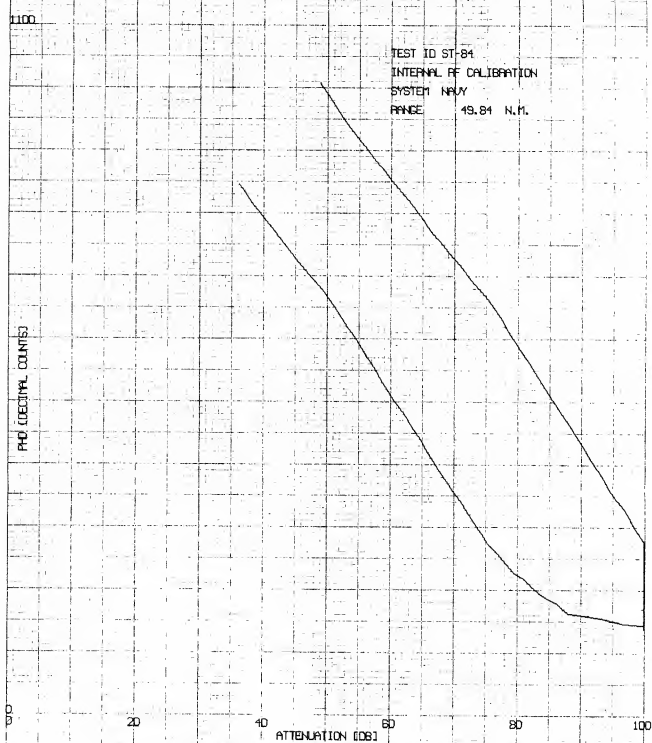
MOD 3 SYSTEM SIGMA

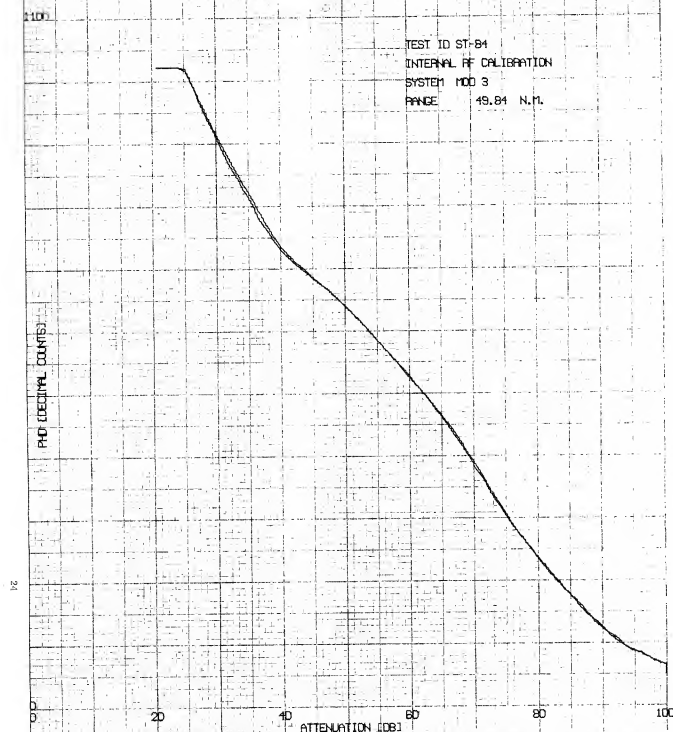
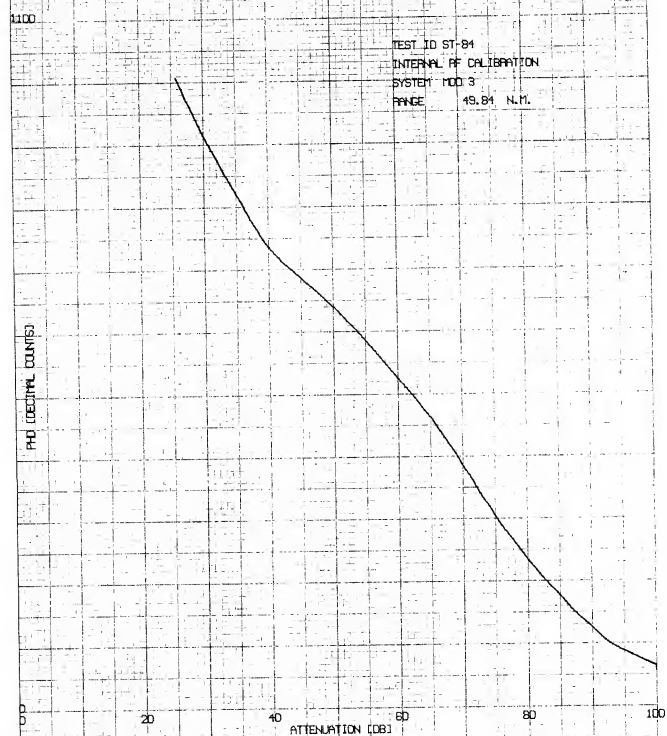


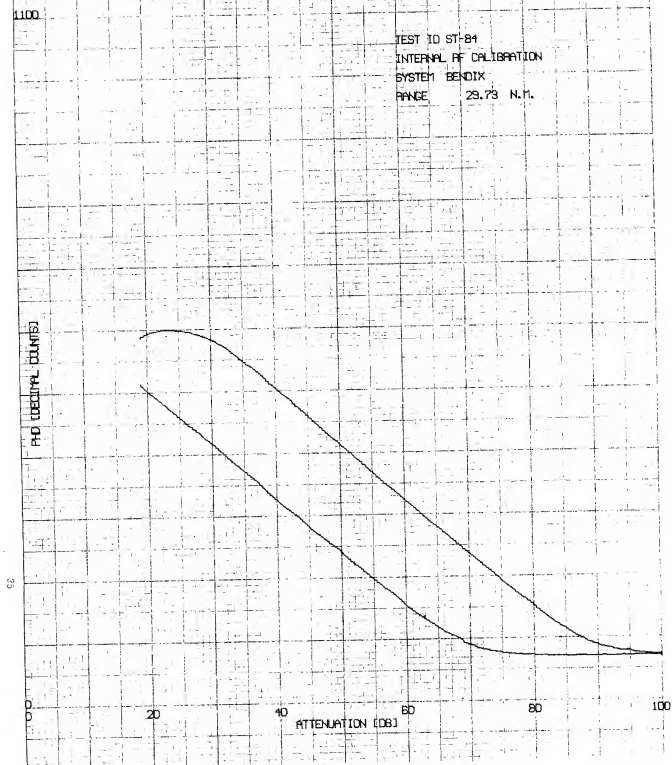
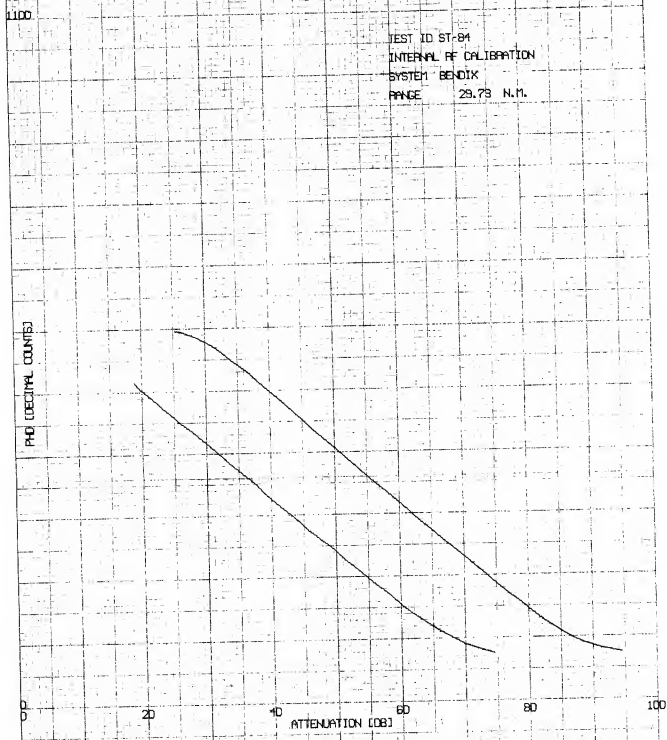


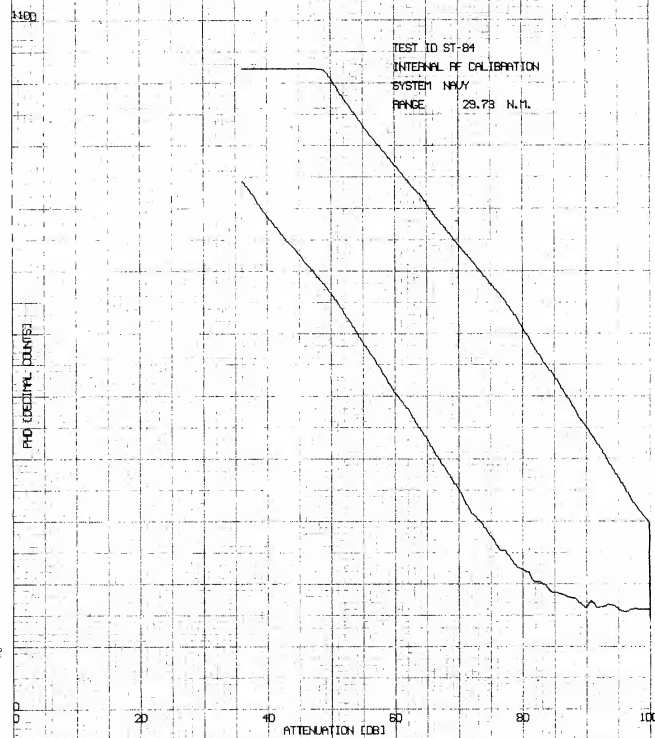
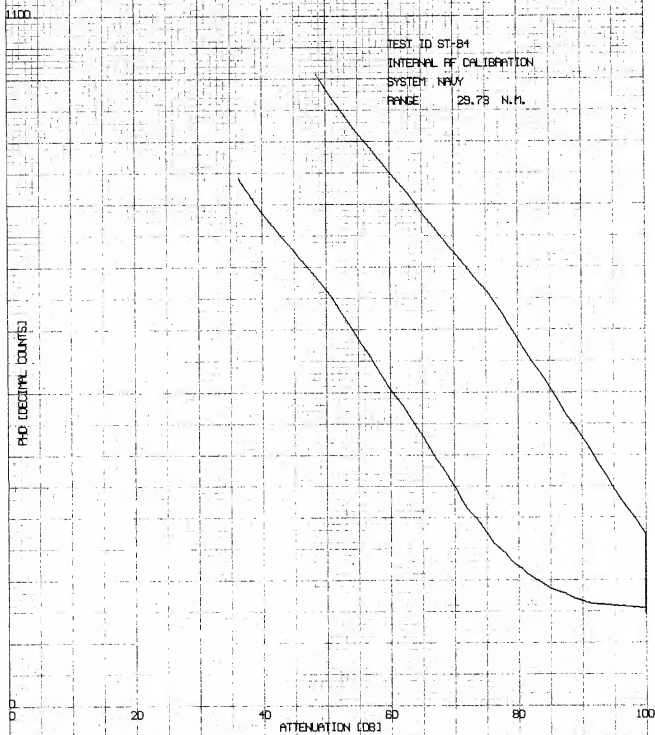
INTERNAL  
R-F CALIBRATIONS

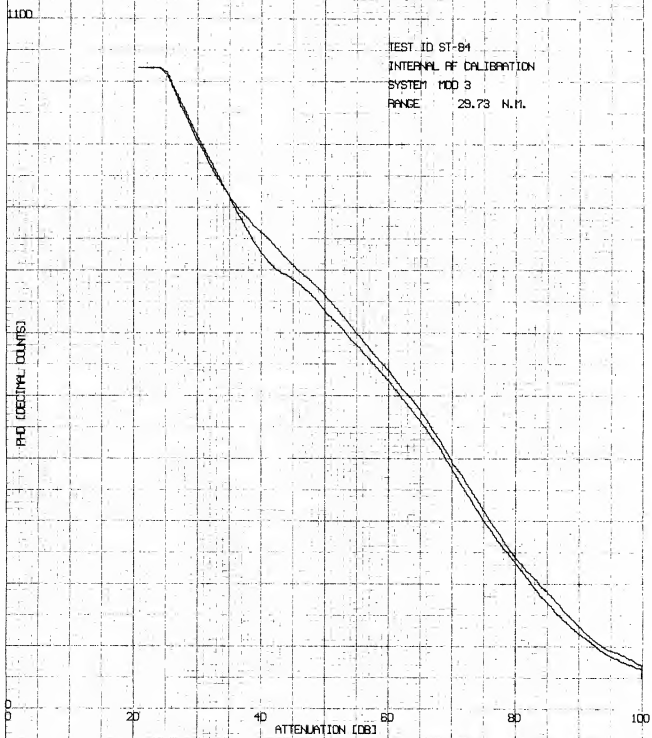
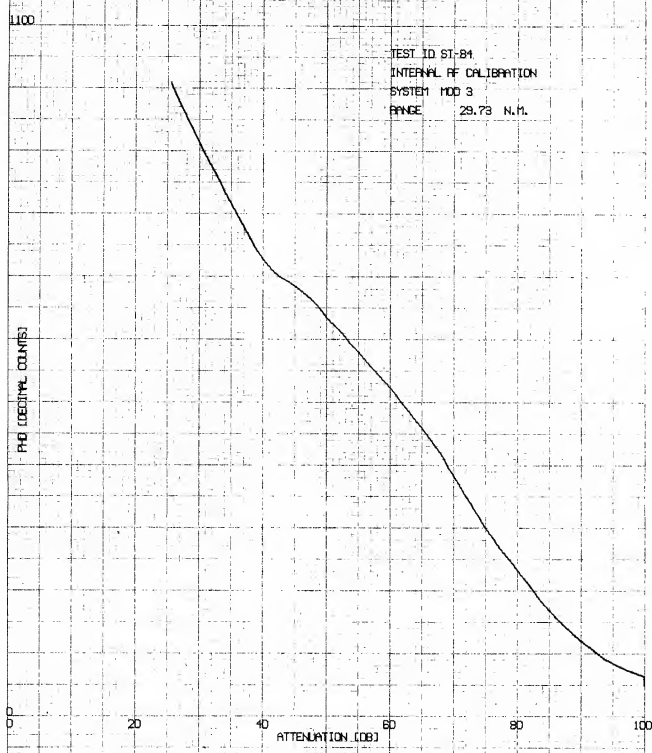


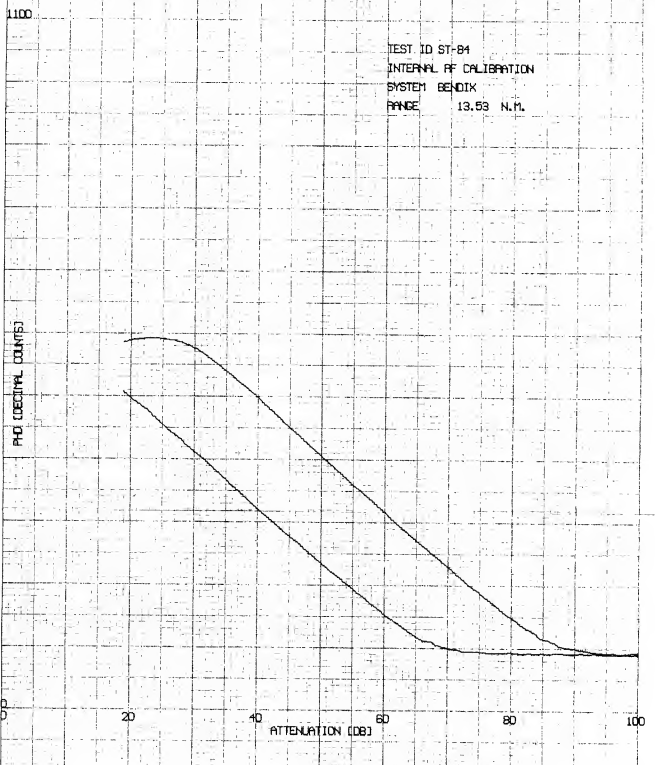
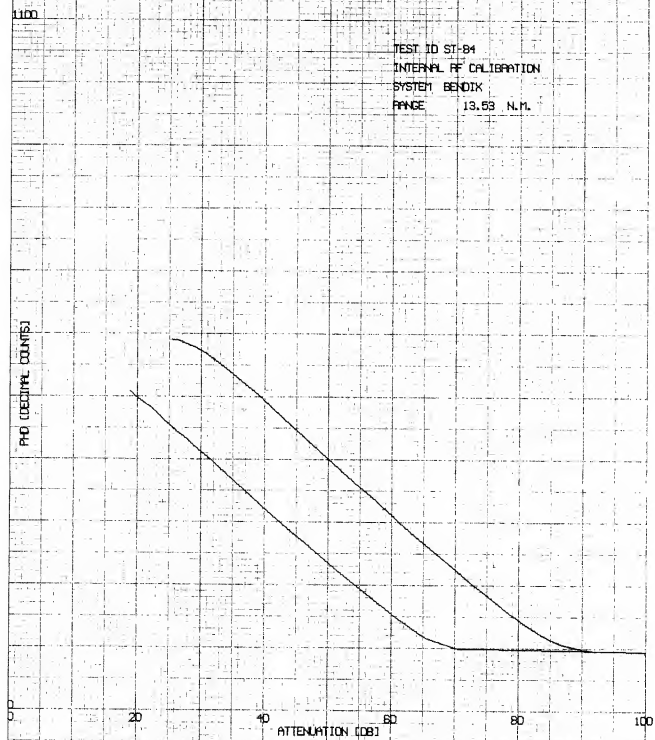




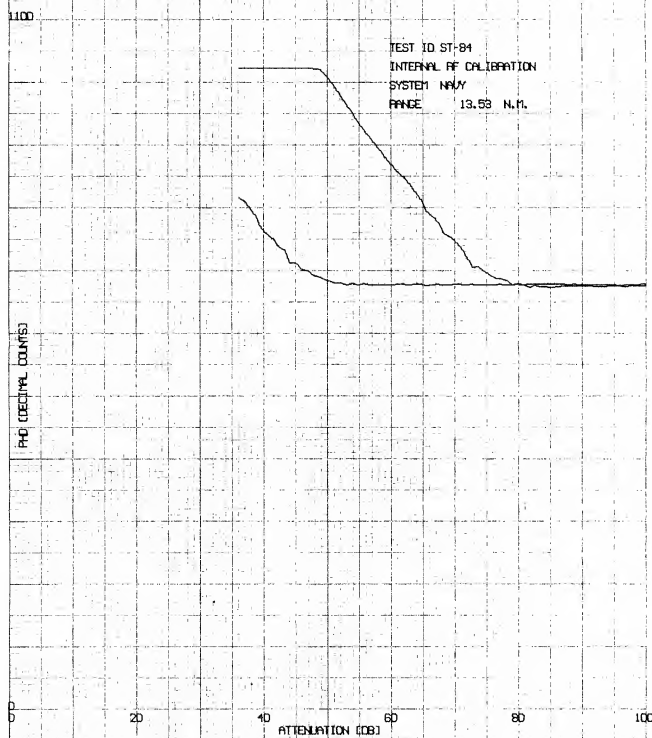
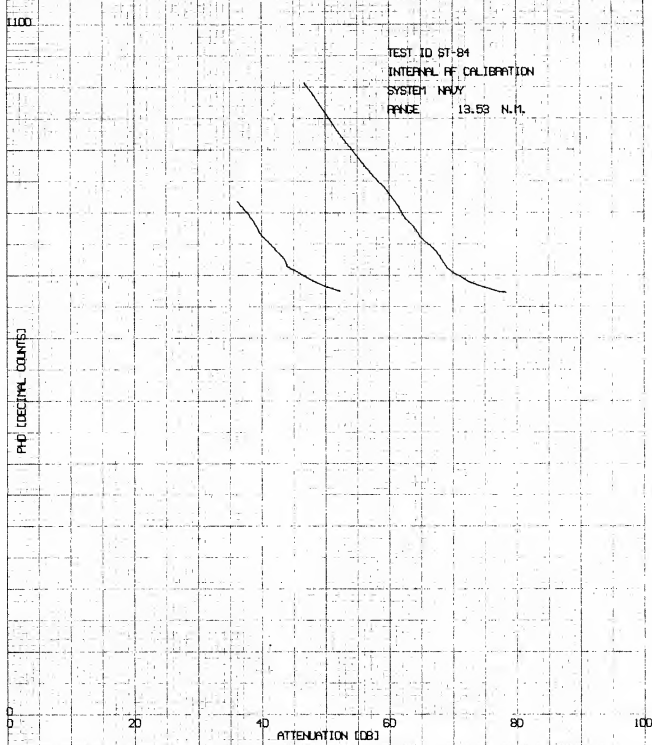


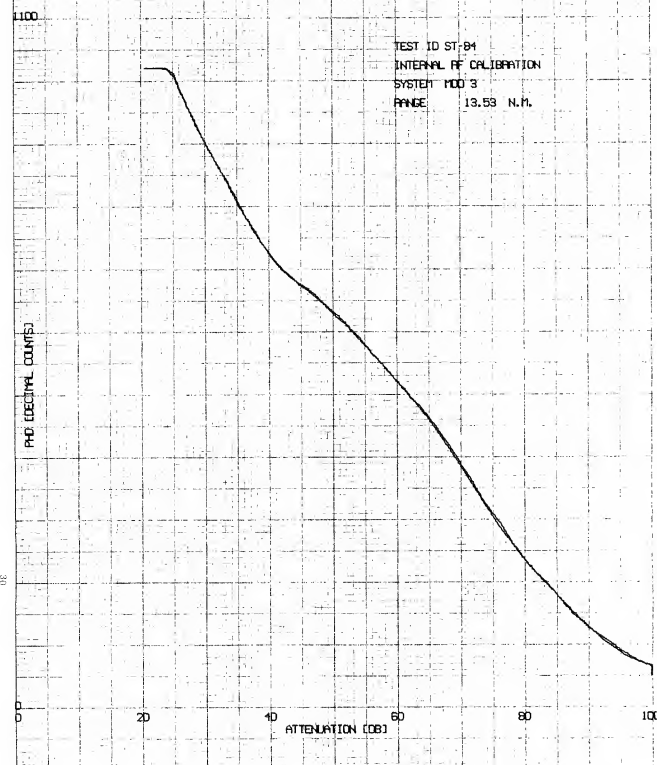
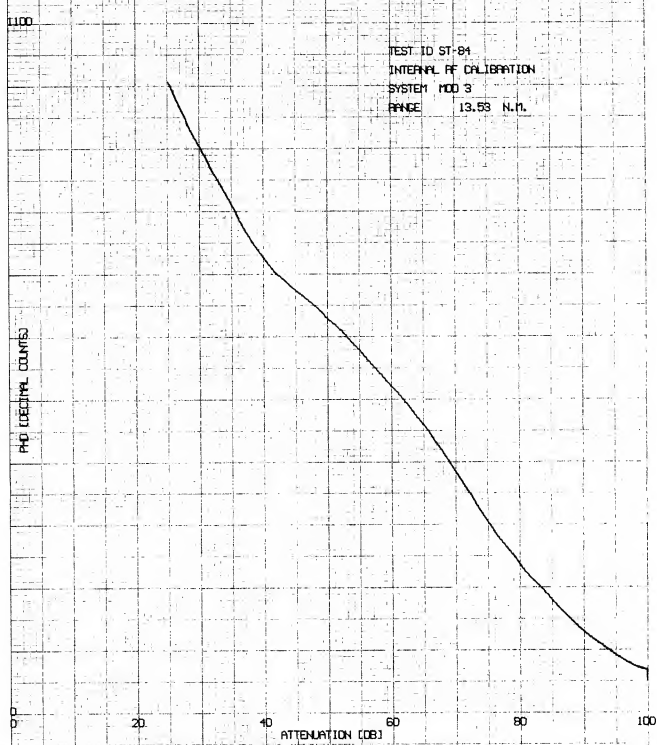












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